Topographic Waves on Slopes

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LONG-TERM GOALS

I seek to understand the influence of midlatitude jets on the surrounding ocean. The interrelations between meandering, radiation of low-frequency energy, and resulting mean flow generation have been of particular interest.

OBJECTIVES

The guiding hypothesis is that the meandering of western boundary currents acts as a wavemaker in the ocean. The meanders are quite depth-independent and force mainly barotropic motions exterior to them. These motions propagate as low-frequency Rossby waves, and those to the north of the stream eventually become topographic Rossby waves as they begin to feel the bottom topography. We intend to study the effects of nonlinearities and steep topography on these waves as they shoal and refract.

APPROACH

The results from an array of current meters, deployed in late summer of 1995 on the Continental Rise to the west of the Grand Banks, are the inspiration for this study (Hogg, 2000). Although an interpretation of the low-frequency variability in terms of topographic Rossby waves was compelling, it was clear that a number of the implicit assumptions were violated: namely small amplitude waves and gentle slopes. To this end we have begun numerical experiments using the Rutgers "ROMS" numerical model. As I had no previous experience in numerical modeling, the initial work has been mainly aimed at learning how to use the model and testing different configurations.

WORK COMPLETED

Gaining proficiency in numerical modeling has been one activity for the present grant year. The other has been to collaborate on a manuscript that describes results from mooring work in the Ulleung Basin of the Japan/East Sea. Although we were directly involved with just one mooring for 2 settings, this paper describes additional moored and hydrographic measurements made by Korean investigators and attempts to relate them to the published numerical model results of Hogan and Hurlburt (2000). A paper is in preparation by Chang et al.

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14. ABSTRACT

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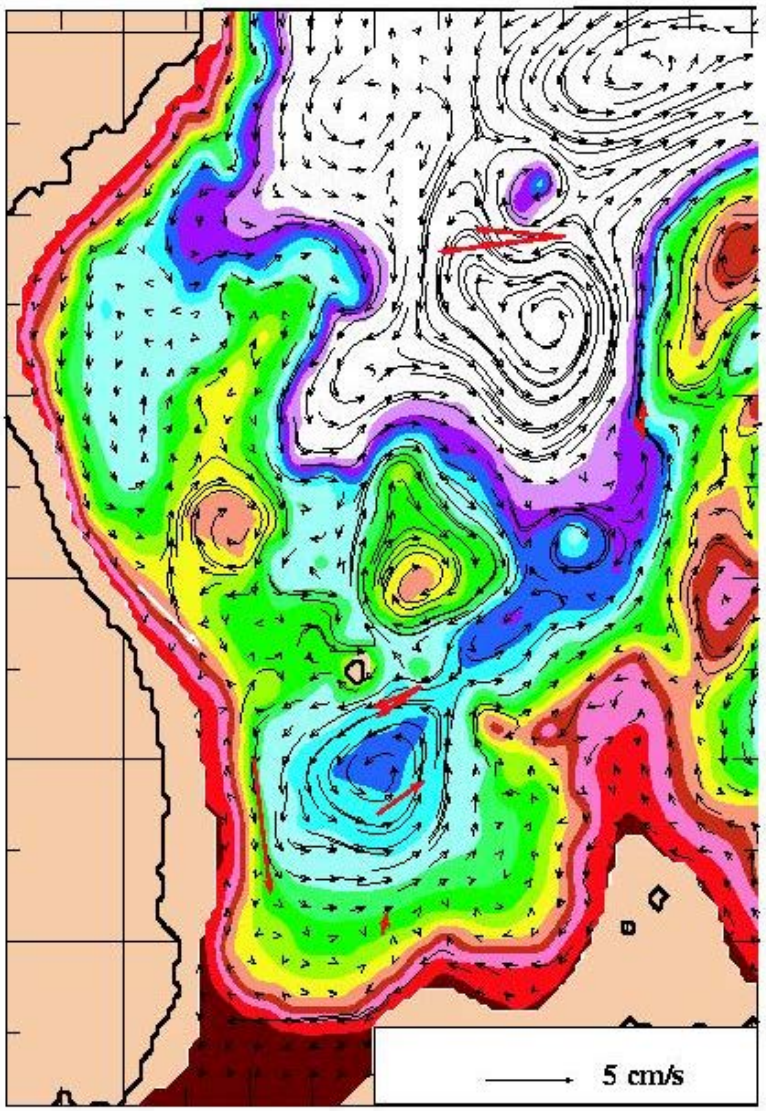
RESULTS

There are no results at the moment from the numerical modeling study, but we do have an interesting comparison between measured deep mean flows and those from the Hogan and Hurlburt (2000) high resolution model. In the figure below, measured near-bottom currents are the red vectors while the model-generated circulation is given by the gridded vectors. Note the dominance of cyclonic flow over depressions (blue to deep blue regions) and anticyclonic flow over shallow regions (yellow–red).



IMPACT/APPLICATIONS

There are two ongoing threads to this research. One is concerned with circulation and variability in the East Sea, which we will continue to examine and for which we intend to write a follow-on paper emphasizing the variability. We expect that these two reports will become important touchstones for modelers who are working on developing realistic models of the region. The other thread is connected

with my own attempts at understanding the processes connected with the shoaling of topographic Rossby waves inshore of the Gulf Stream. I expect that this work will uncover important processes which are currently neglected in larger scale modeling studies because of resolution limitations.

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